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Pharmacognostic, Antihelmintic, Analgesic and Anti-inflammatory Activity of Stem Bark of *Cassia Fistula* Linn

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ABSTRACT

Cassia fistula Linn is used extensively in various parts of the world against a wide range of ailments, the synergistic action of its metabolite production being most probably responsible for the plant's beneficial effects. This article aims to provide a comprehensive study of *Cassia fistula* on 1.Pharmacognostical Study a) Microscopical Evaluation b) Powder drug analysis c)Quantitative analysis d)Physical evaluation.2.Phytochemical investigation a)Collection, authentication and extraction b) Qualitative chemical test of different extracts.3.Chromatographic separation.4) Pharmacological evaluation of the extracts.a) Evaluation of Anthelmentic activity of the different extracts of Cassia fistula on Indian earthworm (Pheritima posthuma).b)Evaluation of Analgesic activity of the different extracts of Cassia fistula linn. By tail flick method on albino rats .c) Evaluation of Anti-inflammatory activity of the different extract of Cassia fistula by caragennin induced mercury Deeping method on albino rats.In traditional medicine, it has been used in the treatment of diabetes, hematemesis, leucoderma, pruritis, intestinal disorder and as antipyretics, analgesic and laxative.Leaves alternate or sometimes subopposite, distinctly petiolate, petioles to 5 cm long, blade long-decurrent on petiole from a subtruncate base, ovate-deltoid, margin slightly wavy-crisped, 2.5-10 cm long, 1-5 cm wide, acute (blunt), lateral veins 4-7 pairs.The microscopical characters of the bark and powder characteristics of the plant were studied.Powder microscopy showed the presence of nonglandular trichomes. Spiral and reticulate vessels were observed. Quantitative microscopy was done.It was observed that Methanol extracts showed maximum anthelmintic activity amongst the ethyl aceatate extracts. The result indicated that the major component responsible for anthelmintic activity may be present in the methanol extracts.And methanol extract at a dose of 300mg/kg body weight showed maximum anti-inflammatory activity amongst other extract.It was observed that ethyl acetate extract at a dose of 400mg/kg body weight showed maximum analgesic activity amongst the other extracts. The result indicated that the major component responsible for analgesic activity may be present in ethyl acetate extract.

Keywords: *Cassia fistula, Phytochemical investigation, anthelmintic, anti-inflammatory, analgesic.*

INTRODUCTION

The genus of Cassia belongs to family Caesalpiniaceae which is well known in Indian system of medicine, commonly known 'Sonali' or 'Bandarlati', has been used in different traditional system of medicines for various ailments since ancient times. [1] Moreover, only a limited number of medicinal plants have received detailed scientific scrutiny thereby prompting the World Health Organisation to recommend that this area be comprehensively investigated. *Cassia fistula* moderate sized deciduous tree, distributed throughout India.[2] It is 8-15 m to 24m in height, with greenish grey smooth bark when young & rough, dark brown when mature. Leaflets 8.12 pair, flowers yellow, long drooping racemes. Pod cylindrical & pulpy. Seeds light brown, hard & shiny. [3] Ayurvedic medicine recognizes the seeds as anti-bilious aperitif, carminative and laxative, hard reddish wood, growing up to 40 feet tall [4]. It is also a purgative due to the wax aloin and a tonic [5] and has been reported to treat many other intestinal disorders like healing ulcers [6] In traditional medicine, *Cassia fistula* is one of the most commonly used plants in Unani and Ayurvedic medicines, this plant has been described to be useful against skin diseases, liver troubles, tuberculous glands and its use in the treatment of haematemesis, pruritus, leucoderm and diabetes has been suggested [7, 8]. Traditionally, the plant is also used as an infusion, decoction, or powder, either alone or in combination with other medicinal plants. [9] In modern times, and in any controlled clinical trials, commercial preparations have tended to be standardized extracts of the whole plant. Many biologically important compounds were isolated and identified from different parts of the plant [10]. The plant extracts were shown as potent antibacterial, antifungal, anti-inflammatory and antioxidant [11] properties and the findings were done using different solvent .The chemical analysis of different parts of *C. fistula* has been reported. It was found to contain flavonoids, phenolic compounds and proanthocyanidins[12]. The selected plant Cassia fistula was reported to have wide ethno medicinal use. The literatures revealed that there is lack of scientific reports on it. So it is important to provide scientific basis in a systemic approach. Easy availability of the plant in Sambalpur district of western Orissa, Wide ethnomedicinal claims of therapeutic activity, Less degree of research findings in the selected plant till date.The small piece of research was performed systemically with the following schedule 1.Pharmacognostical Study a) Microscopical Evaluation b) Powder drug analysis c)Quantitative analysis d)Physical evaluation .2.Phytochemical investigation a)Collection, authentication and extraction b) Qualitative chemical test of different extracts.3.Chromatographic separation.4) Pharmacological evaluation of the extracts.a) Evaluation of Anthelmentic activity of the different extracts of Cassia fistula on Indian earthworm (Pheritima posthuma).b)Evaluation of Analgesic activity of the different extracts of Cassia fistula linn. By tail flick method on albino rats .c) Evaluation of Anti-inflammatory activity of the different extract of Cassia fistula by caragennin induced mercury Deeping method on albino rats.

PLANT DESCRIPTION

PLANT PROFILE

Botanical Name : Cassia fistula Linn.

Botanical Synonym: Golden shower

Family : Fabaceae

Taxonomic Classification

Kingdom : Plantae – plnts

Division : Magnoliophyta

Class : Magnoliopida

Sub class : Rosidae

Order :Fabales

Family : fabaceae

Genus : Cassia

Species : C. fistula

Vernacular names

Hindi - Bendra lathi, dhanbaher

Sanskrit - Aragvadha

Marathi - Bahava

Gujurati - Garmalo

Tamil - konarai

Oriya - sunari

Bengali - Sonalu

Assam - xonaru

Malayalam- Kanikkonna

COLLECTION OF PLANT:

Area of collection:

The plant barks were collected from Naxapali, Sambalpur district of Odisha. The plant barks were collected in morning time. The plant barks were collected in the month of may- June 2021.The sample was identified to be ***Cassia fistula Linn.***

Macroscopical evaluation of cassia fistula linn barks:

Colour - Inner surface - Pale brown

Outer surface - Brown

Odour - Odourless

Taste - Bitter

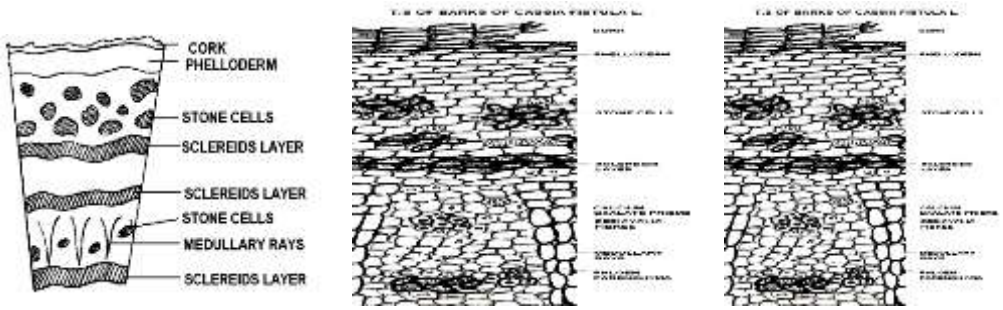
Shape - Single curved, quilled

Fracture - Fibrous

Size - Length : 10 – 15 cm

Width : 3 – 6 cm

Thickness : 5 – 7 mm



T.S of Cassia Fistula Linn. Bark

MICROSCOPY:

Transverse section of Bark

The transverse section of the barks of Cassia fistula L. shows following histological characters:

1. The outer layer is tangentially elongates parenchymatus cells in 3-4 layers of brown colored cork cells.
2. Phellogen- a row of tangentially elongated cells.
3. Phelloderm- wide, parenchymatus interspersed with strands of stone cells.
4. Cortex- composed of loosely arranged cells some of them have found to contain prismatic crystals of calcium oxalate. Stone cells or sclereids were present in the cortex region.
5. A sclereids layer separating the cortex and secondary phloem region.
6. Non-lignified pericyclic fibres are found.
7. Secondary phloem of sieve tubes, companion cells, phloem parenchyma and stone cells.
8. Medullary rays- 2-3 seriate and closely arranged cells.

TABLE NO.1 POWDER ANALYSIS WITH CHEMICAL AGENTS

Reagents	**Colour observed**
Powder	Brown
Powder+ conc. HCL	Violet
Powder + conc.HNO3	Brick red
Powder + conc H2SO4	Deep red
Powder + Glacial acetic acid	Crimson yellow
Powder + Picric acid	Yellow
Powder + Ammonia	Raddish brown
Powder + 5% NaOH	Wine red
Powder + 5% KOH	Creamy
Powder + 5% FeCl2	Blackish green

Fluorescence Analysis:

The fluorescence characteristic of powder drug were studied under U.V. light after treating with different chemical reagents and reported. (Table No 2)

TABLE NO.2 FLUORESCENCE ANALYSIS OF POWDER DRUG

CHEMICAL	***Fluorescence Observed***
Powder + 1n NaOH in Methanol	Blackish red
Powder + 1N NaOH in Water	Crimson Colour
Powder + 50% HCL	Light brown
Powder + 50% HNO_3	Brown
Powder + 50% H_2So_4	Reddish brown
Powder + Petroleum ether	Crimson colour
Powder + chloroform	Light yellow

Powder + Picric acid	Yellow
Powder + 5% ferric chloride solution	Blackish green
Powder + 5% iodine solution	Reddish brown
Powder + methanol	Blackish brown
Powder + HNO_3 + NH_3	Reddish brown

TABLE NO 3, PH OF POWDERED DRUG :

Solution	**1% solution**	**10% solution**
PH	6.77	6.36

QUANTITATIVE ANALYSIS:

TABLE NO.4 DETAILED DATA OF LENGTH AND WIDTH OF PHLOEM FIBRE

3Division of eyepiece micrometer equals to 10 division of stage micrometer or 100µ Therefore 1 division of eyepiece micrometer equals to 100/3 or 3.33µ.

PHLOEM FIBRE		
Sl. No	LENGTH (µ)	WIDTH (µ)
1.	306.36	9.99
2.	133.2	13.32
3.	139.86	9.99
4.	203.13	6.66
5.	119.88	9.99
6.	133.2	16.65
7.	186.48	13.32
8.	306.36	6.66
9.	289.71	9.99
10.	143.19	9.99
11.	176.49	9.99
12.	179.82	13.32
13.	136.53	6.66
14.	173.16	9.99
15.	206.33	9.99
16.	186.48	9.99
17.	233.1	13.32
18.	276.39	9.99
19.	133.2	6.66
20.	226.44	9.99

TABLE NO.5 DETAILED DATA OF DIAMETER OF STARCH GRAINS

SL NO	No. of Divn. Iin e.m.	Diametre in Microns.
1	2	5.714
2	1	2.857
3	3	8.571 (Max)
4	1	2.857
5	2	5.714
6	2	5.714
7	3	8.571
8	2	5.714
9	1	2.857
10	1	2.857
11	2	5.714
12	2	5.714
13	2	5.714
14	2	5.714
15	1	2.857(Min)

PHYSICAL EVALUATION

PHYSICAL EVALUATION PARAMETERS:

TABLE NO.6 DETAILED DATA OF PHYSICAL EVALUATION PARAMETERS

SL. NO	PARAMETER	VALUES (%) W/W
1.	Loss on Drying	5%
2.	Ash Values	
	Total Ash	3.67%
	Acid Insoluble Ash	1.56%
	Water Soluble Ash	2.05%
	Sulphated Ash	0.06%
3.	Extractive Value	
	Water Soluble Extractive	3.86%
	Alcohol Soluble Extractive	0.96%
	Benzene Soluble Extractive	0.02%
	Petroleum Ether soluble Extractive	0.16%

PHYTOCHEMICAL INVESTIGATION OF WHOLE PLANT OF *CASSIA FISTULA Linn.* [13,14,15]

DRYING AND PULVERIZATION:

The collected plant material (Bark) was shade dried at room temperature, then they are pulverized in mixer grinder to coarsely powdered drug and pass through mess size 40 sieve.

PREPARATION OF EXTRACTS BY SUCCESSIVE SOLVENT EXTRACTION:

Method:

The stem barks of *Cassia fistula* were dried in shade and powder to get a coarse powder. About 900 gm of dry bark powder was extracted with methanol by continuous hot percolation using soxhlet apparatus. The extraction was continued for 120 hrs. The methanol extract was filtered and concentrated to a dry mass by using vaccum distillation. A radish brown residue was obtained.

QUALITATIVE PHYTOCHEMICAL EVALUATION:

1. DETECTION OF CARBOHYDRATES

Small quantities of different extracts were dissolved in distilled water separately and filtered. The filtrates were taken for various tests to detect the presence of carbohydrates.

2. Test for Gum and Mucilages

The extracts were treated with absolute alcohol stirred and filtered. The filtrate was dried and examined for its swelling properties. None of the extract answered for the presence of gums and mucilages.

3. Test for Proteins and Amino acids

Small quantities of different extracts were dissolved in few ml of distilled water and subjected to ninhydrin, biuret, millon, xanthoproteic test, test with tannic acid and heavy metals.

4. Test for Alkaloids

Small amount of solvent free various extracts were separately stirred with a few ml of dilute hydrochloric acid and filtered. The filtrates were tested with various alkaloidal reagents such as Mayer's, Drangendroff's, Wagner's and Hager's reagent, Phosphomolibdic acid and Tannic acid.

5. TEST FOR GLYCOSIDES

A small amount of different extracts were dissolved separately in 5ml of distilled water and filtered. Another portion of the extracts were hydrolyzed with hydrochloric acid for one hour on a water bath and hydrolysate was subjected to Legal's, Baljet's, Brontrager's, killerkillini's test and for the presence of cyanogenetic glucoside.

6. TEST FOR PHYTOSTEROLS:

All the extracts were refluxed with 0.5N alcoholic potassium hydroxide until the saponification was complete. The saponification mixture was diluted with distilled water and extracted with petroleum ether .The ethereal extract was evaporated and unsaponification matter was subjected to Liebermann's, Liebermannn-Burchard's and Salkowski's Test.

7. TEST FOR FLAVONOIDS

The different extracts were separately dissolved in ethanol and then subjecyed to the following tests.To a small quuantity of the ethanolic slution, few drops of neutral ferric chloride were added. Blackish brown colour was observed in the methanol and ethylacetate extracts indicating the presence of flavonoids

8. TEST FOR TANNINS AND PHENOLIC COMPOUNDS

The extracts were dissolved in distilled water and filtered. The filtrates were treated with various reagents.

(a) Few ml of filtrates were treated with 5% ferric chloride solution. A bluish black colour was observed in methanol extract indicating the presence of phenolic compounds.

(b) Few ml of filtrates were treated with lead acetate solution. Precipitate was not produced in ethylacetate extract indicating that absence of tannins.

(c) Few ml of filtrates were treated with lead acetate solution. White precipitate were produced in all extracts indicating te presence of tannins.

(d) Few ml of filtrates were treated with strong potassium dichromate solution. Precipitate was not produced in ethylacetate extracts inicating the absence of tannins.

(e) Few ml of the filtrates were treated with potassium ferricyanide followed by ammonia. A deep red colour was observed in methanol extracts indicatig the presence of phenolic compounds.

9. TEST FOR SAPONINS

Foam Test – The extracts were diluted with 20 ml of distilled water and agitated in a graduated cylinder for 15 minutes. Layer of foam was formed in pet.ether extracts indicating the presence of saponins.

THIN LAYER CHROMATOGRAPHIC SEPARATION [16]

Method (Ascending Development):

The plate after spotting of the sample is placed in the chromatography chamber containing at the bottom. The flow of solvent is from bottom to top.

Calculation of Rf Value: RF value = compound distance from origin / solvent front distance from origin.

TABLE NO.10: THIN LAYER CHROMATOGRAPHY OF VARIOUS EXTRACTS

EXTRACT	Rf value	
	Spot.1	Spot.2
Chloroform	0.79	0.88
Pet.Ether	0.61	0.65
Methanol	0.98	0.99
Ethyl acetate	0.83	0.86

ANTHELMINTIC ACTIVITY OF THE BARKS OF *CASSIA FISTULA LINN*. [19]

Anthelmintic: Many humans harbour helminthes (worms) of one species or another. In some cases these infections result mainly in discomfort and do not cause substantial ill health. Some worm infections like schistosomiasis and hookworm disease can produce very serious morbidity. In many countries, particularly those in tropical and subtropical regions, almost all the indigenous population is infected with hookworm and/or other helminthes and the problem of the treatment of helminthiasisis one therefore one of very great practical importance.

Materials:

(a) Adult Indian earthworm (*Pheritima posthuma*.)

(b) Petri dishes.

(c) Tween 80 (1%.)

(d) Normal saline.

(e) Albendazole.

(f) Distilled water.

Method:

The suspensions of various extracts were prepared in Tween 80 (1%) to obtain 1, 2.5 and 5% concentrations. Solutions of similar concentrations of the reference standard drug albendazole were also prepared in distilled water.

Two ml of each concentration of various extracts and standard drug albendazole were diluted to 10 ml separately with normal saline and poured in petridishes. The petridishes were divided into 6 groups. Group I consists of normal saline, Group II consists of standard drug albendazole and Group III to VI consists of four extracts. Each group consists of 1, 2.5 and 5% concentrations and to each concentration equal size of adult earthworms of 6 numbered were released into petridishes. Times were recorded at the time of releasing the earthworms to each concentration. Then the time was taken in minutes for the paralysis and death of the earthworms. The anthelmintic activity was evaluated on adult Indian earthworm *Pheritima posthuma* due to its anatomical and physiological resemblance with the intestinal round worm parasites of human beings.

Paralysis was said to occur when the worms did not revive even in normal saline. Death was concluded when the worms lost their mobility followed by fading away of their body colour.

Methanol and Ethyl acetate extracts of the barks of Cassia fistula linn. Were screened for anthelmintic activity.

Result:

It was observed that Methanol extracts showed maximum anthelmintic activity amongst the ethyl aceatate extracts. The result indicated that the major component responsible for anthelmintic activity may be present in the methanol extracts.

Data was expressed as mean ± SEM.

TABLE NO: 11: ANTHELMINTIC EFFECT OF THE BARK OF *CASSIA FISTULA LINN.*

Group	**Concentration of extract in %**	**Time taken in minutes ± SEM**	
		Paralysis	**Death**
Albendazole	1.0	30.6±0.33	41.3±1.45
	2.5	24.00±1.52	37.00±1.4
	5.0	16.6±0.88	28.6±1.2
Methanol extract	1.0	78.33 ±1.47	129.66±1.4
	2.5	73.05±0.58	117.66±1.31
	5.0	69.66±0.91	97.3±1.73
Ethyl acetate extract	1.0	101.66±1.28	122.66±1.047
	2.5	72.66±1.83	95.33±1.86
	5.0	58 ± 0.32	81±2.46

Control worms were alive upto 24 hrs. of observation.

ANTI INFLAMATORY ACTIVITY OF STEM BARK OF *CASSIA FISTULA LINN. [17]*

Materials

- Adult wistar albino rats 130-160 gm.
- Std drug Ibuprofen I.P
- Extract's
- Carrageenan (himedia labs.)
- Sodium C.M.C
- Plysmethograph.

Method:

Adult rats of 130-160 gm were taken and kept in polypropylene cages under standard condtions of 12:12 light and day cycles. They are fed with standard diet. Anti-inflammatory activity was evaluated using carrageenan induced hind paw edema method. Rats of either sex were divided into six groups of three animals each. The first group A served as control and received only vehicle, second group was administered standard drug Ibuprofen I.P 100mg / kg intra peritonially. The animals of third to sixth group were treated with petroleum ether, chloroform, methanol and ethylacetate extract, orally.After 30 minutes of above treatment 0.05ml of 1% w/v Carageenan in saline was injected into subplantar tissue of left hind paw of the animals.

The degree of paw edema of the entire group was measured at 0,30,60,90 and 120 minutes after administration of carrageenan. The anti – inflammatory affect was expressed as percent inhibition of edema.

Result: It was observed that methanol extract at a dose of 300mg/kg body weight showed maximum anti-inflammatory activity amongst other extract.

TABLE NO. 12: ANTI-INFLAMMATORY EFFECT OF THE BARK OF *Cassia fistula Linn.*

Sl. No.	Treatment	0 MIN	30 MIN	60 MIN	120 MIN
1.	Control	4.77 ± 0.026	5.33 ± 0.035	5.54±0.039	5.90 ± 0.043
2.	Ibuprofen	4.25±0.04	4.63 ± 0.07**	4.53±0.04*	4.56±0.08*
3.	Methanol extract	8.22±0.03	8.02±0.06**	5.35±0.05*	5.02 ± 0.03**
4.	Pet ether extract	13.21±0.04	10.27 ± 0.08**	9.91 ± 0.06**	8.09 ± 0.05**
5.	Chloroform extract	7.73±0.06	9.87±0.05	8.13 ± 0.35**	7.96±0.07**
6.	Ethyl acetate extract	12.10±0.05	14.19±0.06**	12.00±0.02**	11.73±0.1*

Mean paw thickness ± SEM, "*" indicates p< 0.05,"**"p< 0.01

Percentage inhibition of oedema is indicated in parenthesis

ANALGESIC ACTIVITY OF THE STEM BARK OF *CASSIA FISTULA linn[18]*

Materials:

(a) Albino rats

(b) Thermometer

(c) Various extracts

(d) Diclofenac sodium

(e) Sodium lauryl sulphate 0.5% w/v solution

(f) Gastric tube

Method:

Healthy Wister strain albino rats weighing about 60-120 gm were taken. They were divided into 6 groups having 3 each and numbered. They were then placed into individual restraining cages leaving the tail hanging out freely. The animals are then allowed to adapt in the cages for 30 minutes before testing. The lower 5cm portion of the tail was immersed in a cup of freshly filled water of exactly 55ºC. Within a few seconds the rat reacts by withdrawing the tail. The reaction time was recorded in 0.5 seconds by a stop watch. After each determination the tail was carefully dried. The reaction was determined before oral feeding of the drug and various extracts which was recorded as zero minutes reading. The control, standard and test substances were given to the animals by gastric tube. After the drug was administered the reaction time was recorded at an interval of 30, 60,120,180 minutes. The mean reaction time was found out for each group and compared with the value of standard drug. The standard error was found.

Control:

The animals marked group - I received orally 1ml/100gm of body weight of 0.5%w/v solution of sodium lauryl sulphate and served as control.

Standard:

The animals marked group – II received orally 45mg/kg body weight of diclofenac sodium in 0.5%w/v suspension of sodium lauryl sulphate and served as standard.

Test:

The animals marked test group – III to VI received 400mg/kg body weight of various extracts.

Chloroform, Ethanol and Aqueous extracts of the bark of *Cassia fistula linn* were screened for analgesic activity.

Result:

It was observed that ethyl acetate extract at a dose of 400mg/kg body weight showed maximum analgesic activity amongst the other extracts. The result indicated that the major component responsible for analgesic activity may be present in ethyl acetate extract.

Data was expressed as mean ± SEM and the statistical difference between the groups was analyzed by using Student's t-test. The value of p<0.05 was considered as statistically significant.

TABLE NO: 13: ANALGESIC EFFECT OF THE BARK OF *CASSIA FISTULA linn*

Sl. No.	Treatment	Initial Time(s)	½ Hour	1Hour	2 Hour
1.	Control	2.46±0.25	3.5±0.28	4.03±0.23	4.73±0.42
2.	Diclofenac sod.	2.4±0.18	2.26±0.43	2.46±0.38	2.3±0.34
3.	Methanol extract	2.08±0.23	1.88±0.42	2.57±0.15	2.94±0.06
4.	Chloroform Extract	1.99±0.49*	2.27±0.29	2.53±0.52*	2.76±0.43*
5.	Ethylacetate Extract	2.14±0.42	2.45±0.25	3.76±0.64	3.97±0.22

Mean± SEM, "*" indicates $p<0.05$

DISCUSSION AND CONCLUSION

Cassia fistula is a annual herb, coarse and foetid with subopposite deciduous leaves. This is an annual, erect, branched, hairy plant 15 to 50 centimeters in height belongs to the family Boraginaceae. It can also be found at higher elevations. It is found in pastures, wastelands, cultivated lands, roadsides, lawns and planted forests

Leaves alternate or sometimes subopposite, distinctly petiolate, petioles to 5 cm long, blade long-decurrent on petiole from a subtruncate base, ovate-deltoid, margin slightly wavy-crisped, 2.5-10 cm long, 1-5 cm wide, acute (blunt), lateral veins 4-7 pairs.

The microscopical characters of the bark and powder characteristics of the plant were studied. Some isolated epidermal cells in surface view, irregular in outline, without any intercellular space & Parenchymacells with crystals are present. We also obseved spirally thickened vessel members and traceids; members short with horizontal end wall and simple perforation plate, Round to ellipsoidal chloroplasts in parenchyma cells; Long, narrow, pitted fibres with pointed end, Columnar palisade cells & Lacunar collenchyma cells, are present.

Powder microscopy showed the presence of nonglandular trichomes. Spiral and reticulate vessels were observed. Collenchymatous cells, anisocytic stomata and cluster of calcium oxalate crystals were seen. In the powder analysis the powders were treated with different reagents and different colours were seen on naked eye as well as on UV light. pH of 1% solution and 10% solution of powdered were 8.25 and 8.31.

Quantitative microscopy was done. Linear measurements of different trichomes were multicellular branched covering trichomes (stellate) (68.75µ - 124.75µ - 225µ, 25µ - 34µ - 50µ) and multicellular uniseriate stalk and unicellular head glandular trichomes (75.00µ – 118.51µ – 225µ, 22.916µ – 28.333µ – 33.333µ). Average vein-islet and vein termination numbers were 34.4 and 17 respectively. Dimension of calcium oxalate crystals were (12.5µ – 20.25µ – 31.25µ). Average stomatal numbers of the leaf of the upper and lower epidermis were 12.5 and 16.33 respectively. Average stomatal index of the leaf of the upper and lower epidermis were 16.77 and 19.83 respectively.

Methanol and Ethyl acetate extracts of the barks of *Cassia fistula linn.* were screened for anthelmintic activity. It was observed that Methanol extracts showed maximum anthelmintic activity amongst the ethyl aceatate extracts. The result indicated that the major component responsible for anthelmintic activity may be present in the methanol extracts.

It was observed that methanol extract at a dose of 300mg/kg body weight showed maximum anti-inflammatory activity amongst other extract.

It was observed that ethyl acetate extract at a dose of 400mg/kg body weight showed maximum analgesic activity amongst the other extracts. The result indicated that the major component responsible for analgesic activity may be present in ethyl acetate extract.

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Conflict of interest:

There is no conflict of interest at all.

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